The Ultrasonic Detection of a First Order Phase Transition in Solid Solutions Gd-Y

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The complex electronic structure of rare-earth metals generates numerous features in the thermophysical properties of the related metallic systems. The variety of magnetic and crystal phases realized in the rare-earth based compounds and alloys [1] gives a lucky opportunity to study the nature of spin-lattice interactions in solids.

We have studied the temperature behavior of acoustic properties of the polycrystalline $Gd_{1-x}Y_x$ (x=0,0.055,0.075,0.102,0.12) substitution alloys using the two-component oscillator technique for longitudinal and torsional standing waves at the frequencies 54 < v < 93 kHz between 78 and 300 K. The ultrasonic measurements were accompanied with the measurements of a.c. magnetic susceptibility at the frequency 100 Hz.

Three types of anomalies were observed in the temperature dependencies of the measured values: the λ -type anomaly at Curie temperatures, the spread anomalies lower 200 K, and the very sharp δ -function-like attenuation peaks and corresponding velocity dips which were revealed only in the yttrium containing samples in a narrow temperature range of about 1.5 K located near 248 K for all $x \neq 0$. The temperature hysteresis was observed in the region 248 < T < 200 K, as well as the small temperature hysteresis about 0.5 K of the λ -peak itself. The magnetic susceptibilities reflect the transition too.

We have interpreted the last anomaly as a first order phase transition; that was confirmed by the thermal expansion experiments [2]. The surprising feature of the anomaly consists not only in its presence (it is accepted that for x < 0.2 there is no phase transformations in these systems in this temperature region [1]), but in its independence of x unlike the Curie and spin reorientation temperatures. We assume that the origin of this transition is a spin-lattice coupling, and that it is connected with change of a character of magnetic order in the system.

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- [1] K.N.R Taylor and M.I. Darby, *Physics of Rare Earth Solids*, Chapman & Hall Ltd (1972).
- [2] V.P. Popov, A.B Beznosov, E.L. Fertman, N.N. Chebotayev, and E.A. Uzbek, to be presented at 13th Symposium on Thermophysical Properties, Boulder, CO (June 22-27, 1997).